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PERMIT TO WORK SYSTEM

FOR PIPED MEDICAL GASES, MEDICAL COMPRESSED AIR AND MEDICAL VACUUM INSTALLATIONS

SUPPLEMENT TO HTM 22

SUPPLEMENT TO HEALTH TECHNICAL MEMORANDUM NO. 22

PERMIT

PART 1 HAZARD LEVEL _____ ENGINEER

PERMISSION _____ DOCTOR/NURSE

PART 2 DETAIL OF ISOLATION

_____

WORK TO BE DONE

_____

OTHER PERMITS IN USE _____ENGINEER

PART 3 ACCEPTANCE OF RESPONSIBILITY FOR WORK _____FITTER

PART 4 CERTIFICATE OF ENGINEERING TESTS

_____ENGINEER

PART 5 TESTS AND AUTHORISATION FOR USE AFTER HIGH HAZARD WORK

_____ENGINEER _____PHARMACIST

PART 6 TESTS AND AUTHORISATION FOR USE AFTER MEDIUM HAZARD OR LOW HAZARD WORK

_____ENGINEER

Department of Health and Social Security: London

Welsh Office Cardiff

Supplement to Health Technical Memorandum Number 22

Permit to Work System

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Section 1 Introduction

1.1 **General**

1.1.1 Safety rules and procedures for medical gases installations are required to ensure that an adequate, safe and reliable service is provided for patient care. They are not specifically for the protection of people working on the system from danger, since this is not great. The potential hazard to patients arises from terminal units either incorrectly labelled or incorrectly assembled, cross-connection of hoses, incorrect pressure settings or sudden disruption of supply without the knowledge and permission of the medical or nursing staff.

1.1.2 Permit to Work certificates should always be used to control engineering work however minimal, in order to protect patients, staff and medical gases plant. They are necessary to co-ordinate the co-operation of medical and nursing staffs, pharmacists and administrators, as well as the engineering department staff or contractors staff. They are particularly necessary when the actions of one group can directly, or indirectly expose others to a hazard, or create difficulty in operation.

1.1.3 It is important to ensure that all persons likely to be affected by disruption of the piped service are told the date, time and probable duration of the interruption.

1.1.4 It should be remembered that systems using Permits for the authorisation of work require the fullest co-operation of all staff and their acceptance of the responsibilities involved. It is not enough that heads of hospital departments understand their use. Every person likely to be affected by the issue of Permits must clearly understand the dangers in the misuse of the Permit system and adhere to the conditions specified on the Permit.

1.1.5 The recommendation to appoint engineers as Authorised Persons should be made only by Area Engineers who have themselves received specific training (1) and have specialist knowledge of the safety requirements of medical gases installations. The Area Engineer who makes the recommendation should normally be a Chartered Engineer.

1.1.6 Specialist contractors staff may be appointed by Area Engineers as Authorised Persons, for specific works, on recommendation in writing by their employers, who would be expected to ensure that the person concerned was qualified as in 3.7.1 and 3.7.2; but see 4.10.2.

Section 2 Scope

2.1 **General**

2.1.1 The Permit to Work system is applicable to the servicing, repair, alteration and extension of existing installations within a hospital, or any action, such as the closure of an isolating valve, which restricts the supply. This means that Permits shall also be obtained before any major item of central plant, eg manifold, control panel, compressor, or vacuum pump (including any standby plant), is isolated prior to servicing, repair or overhaul.

2.1.2 The system is applicable to work on installations already in service.

2.2 **Routine changing of cylinders**

2.2.1 Permits are not necessary for the routine replacement of cylinders on manifolds nor for the recharging of liquid oxygen vessels, provided there is no danger of the supply being disrupted when these tasks are undertaken.

2.3 **Planned preventive maintenance (PPM) work**

2.3.1 Permits will not be required for routine daily or weekly inspections (where the service is not interrupted), but follow-up work will usually involve the issue of a Permit. Other PPM inspections will involve the issue of a Permit.

2.4 **Substantial alterations, extensions to, or overhaul of existing installations**

2.4.1 The system requires that work described on the Permit should normally be completed in one day, though provision is made for some carry-over. Work likely to take more than one day may be initiated on the lines indicated in Parts 1 and 2 of the Permit, but should be carried out under normal procedures for engineering work of this nature and commissioned in accordance with the requirements of Hospital Technical Memorandum No 17 - Commissioning of Hospital Engineering Services. [This limitation does not normally apply when Permits are issued for the overhaul of central plant.]

2.4.2 Capital works undertaken by the Regional Health Authority, delegated schemes carried out under the supervision of (or by) the Regional Health Authority's Works Department and other similar new work should be connected to an existing system only after a break point has been established, as in Appendix 3 under a Permit to Work. The new capital work should be tested and commissioned in the normal manner as provided for in HTM 17.

2.5 **Levels of Hazard**

Three orders of hazard occur when work is to be carried out on any part of a piped medical gas installation which is currently in use. They are broadly defined below but the Authorised Person will be able to assess the hazard level at the time of preparing the Permit and if in doubt he will assess the hazard in the higher of two categories. The higher the hazard the greater the care required in the re-commissioning procedure.

(1) Training is provided at the Hospital Engineering Centre, Falfield

2.5.1 **High hazard work**
This will include any work involving the cutting of an in-service pipeline, and any work in which brazing is required. Such work introduces hazards of cross connection and/or pollution and causes inconvenience to staff.

2.5.2 **Medium hazard work**
This will include work at any terminal unit location, boom or pendant where there is a piped service of more than one medical gas in addition to a piped medical vacuum service. This would be the case in many operating theatres, anaesthetic rooms, intensive therapy units etc. Such works introduce hazards of cross connection in booms and pendants but little or no hazard of pollution. They usually cause inconvenience to staff. The hazard of cross connection in booms or pendants will be minimised when hoses are fitted with the non-interchangeable connectors described in the new British Standard (1) and in all situations where the terminal units comply either with the requirements of para 11 (vi) of HTM 22 or with the new British Standard.

2.5.3 **Low hazard work**
This will include work on terminal units *ONLY* and in situations in which there is a piped service of one gas only, for example oxygen, or in addition to a piped medical vacuum service. This would be the case in most ward situations. These works introduce little or no hazard of cross connection but may cause inconvenience to patients and staff. There are, however, 2 sub-categories in this class of hazard, which depend upon the type of terminal unit in use, as follows:-

2.5.3.1 **Terminal units which comply with Paragraph 11(vi) of HTM 22 or the British Standard**
2.5.3.1.1 The class includes the BOC Mark 3, the Draeger HTM 22 Type, the Puritan (Vickers) Series A, Puritan Old Type (Modified) units. (These do not comply with the requirements of the British Standard but they meet those of HTM 22).
2.5.3.1.2 When these are dismantled for repair or replacement of the main working components it is not possible to re-assemble them with parts designed for another gas service, except by a wilful act on the part of the fitter, for example by cutting or removing non-interchangeability keys. It is thus not possible to supply gas to a patient by inserting a probe into a hazardous terminal unit, for example an assembly comprising an *oxygen* pipe termination block and a *nitrous oxide* outlet. [In practice these components can be partially but wrongly assembled.]
2.5.3.1.3 When work on an individual terminal unit is required because for example it is leaking, it is possible to isolate the supply to that terminal unit alone, by means of its integral isolating valve, while work proceeds or while spares are obtained. In such an event it is, therefore, not necessary to interrupt the supplies to other adjacent terminal units.
2.5.3.1.4 Work on this class of terminal unit causes no hazard and little or no inconvenience to patients or staff.

2.5.3.2 **Terminal units which do not comply with Paragraph 11(vi) of HTM 22 nor with the new British Standard**
2.5.3.2.1 The class includes the BOC Mark 1 and Mark 2, the Draeger Old Pattern and other Puritan (Vickers) units. These Puritan terminal units incorporate an integral isolating valve, so they do not suffer from the limitation in 2.5.3.2.3.
2.5.3.2.2 When these are dismantled for repair or replacement it *IS* possible to assemble them with components designed for the service of another gas (cf 2.5.3.1.2)
2.5.3.2.3 In order to work on one of this class of terminal units it may be necessary to isolate the supply to a whole ward or Department or in some cases to several wards (but see 2.5.3.2.1).

Section 3 Definitions

3.1 **Permit to work**
A form of declaration or certificate in six parts, for signature as appropriate. It states the degree of hazard involved, defines all services to be worked on, and the points where isolation of the affected sections are made. It also gives an indication of the work to be carried out. It is not a Permit for the use of the installation for clinical purposes until either Part 5 or Part 6 has been completed. The Form is illustrated in Appendix 1.

3.2 **Medical Gases Installations**
The fixed medical gases pipeline and the associated central storage or pumping equipment; this definition includes medical compressed air and medical vacuum installations.

3.3 **HTM 22**
Health Technical Memorandum No 22 - Piped Medical Gases, Medical Compressed Air and Medical Vacuum Installations (first published by HMSO for the Department of Health and Social Security as Hospital Technical Memorandum No 22 in May 1972 and as amended by HN(76)175)

3.4 **Medical Officer**
For the purpose of this procedure the doctor who is directly involved in the Department or Unit that will be affected by work on the Medical Gases Installations.

3.5 **Suitably Qualified Person**
A Pharmacist nominated by the Health Authority, after consultation with the Area Pharmaceutical Officer and the Regional Principal Pharmacist (Quality Control).

3.6 **Authorised Nurse**
For the purpose of this procedure the nurse who is in overall charge of the Department or Departments.

3.7 **Authorised Person**
Note: This person may be the "Responsible Officer" referred to in paragraphs 3 and 220 of HTM 22 or one of

(1)The draft is now out for comment

the specialist contractors staff referred to in 1.1.6 above and 3.7.3 and 4.10.2 below.

3.7.1 A person who has sufficient technical knowledge, training and experience to enable him to understand fully the dangers involved and who is appointed in writing by the Area Authority. The certificate of appointment should state the class of work which the person is authorised to initiate and the extent of his authority to issue and cancel Permits to Work.

3.7.2 He should have read, have understood and be able to apply the guidance in HTM 22, especially in relation to testing and commissioning. He should be completely familiar with the medical gases pipe routes, their means of isolation, and the central plant. He should ensure that the work described in the Permit is carried out to the necessary standards.

3.7.3 The Assistant Hospital Engineer has not always sufficient experience to be appointed. Site Engineers and Commissioning Engineers may be appointed as Authorised Persons, provided that the Area Authority is satisfied that they have the necessary knowledge and experience. (See also 1.1.6 and 4.10.2)

3.8 **Competent Person**

3.8.1 A person having sufficient technical knowledge, training (1) and experience to enable him to carry out his duties in a competent manner and understand fully the dangers involved, and whose name is on the Register of Competent Persons maintained by the District Engineer or appropriate person. (See also 4.10.2)

3.8.2 He should be familiar with and able to read the record drawings.

3.8.3 He should be able to identify all types of medical gases terminal units and shall be familiar with all testing and commissioning procedures referred to in HTM 22. The person maintaining the register should assess a person's competence, taking account of his training and experience.

Section 4 Principles and Operational Considerations

4.1 **Permit issuing authority and control of Permit books**

4.1.1 The issuing authority should normally be the Hospital Engineer or Assistant, being an Authorised Person, but Permits may be issued by any other Authorised Person.

4.1.2 A new book of Permits should not be taken into use until the old book is completely used and accounted for.

4.2 **Liaison with Medical and Nursing Staff**

4.2.1 The procedures allow work to proceed on a piped medical gases installation only with the knowledge of the Suitably Qualified Person and the permission of either the Medical Officer or an Authorised Nurse. An Authorised Nurse would be competent to grant permission in all cases where the Authorised Person (the Engineer) indicates in Part 1 of the Permit to Work that the work is of a Low Hazard nature (see 2.5.3). The Authorised Nurse might be competent in some cases to grant permission for work of a Medium Hazard nature (see 2.5.2). No work of a High Hazard nature (see 2.5.1) should be permitted without the approval of a Medical Officer.

4.2.2 The approval of the Medical Officer should normally be obtained before any interruption is caused to the supply of a gas affecting more than one ward or department of a hospital. This approval may be given by an Authorised Nurse in circumstances to be agreed locally and subject to periodic review by those concerned. These agreements should be recorded.

4.2.3 There should be general agreement between the Authorised Person and the Medical and Nursing Staff on the length of advance notice which will normally be required before interruptions of piped medical gases services may be made, this might, typically, be 48 hours for fully pre-planned work.

4.2.4 In the case of an emergency, eg a serious leak of nitrous oxide, previous approval for the interruption of the supply may have to be dispensed with.

4.3 **High Hazard Work**

4.3.1 When work of a High Hazard nature has been carried out the Authorised Person, assisted by the Suitably Qualified Person, shall check the identity, quality and purity of the gas at each terminal unit on which work has been carried out, or which may have been affected by the work.

4.4 **Medium Hazard Work**

4.4.1 When work of a Medium Hazard nature has been carried out the Authorised Person shall carry out a Gas Identity Check at each terminal unit on which work has been completed, before certifying that the installation is suitable for use.

4.5 **Low Hazard Work**

4.5.1 The principles governing work of a low hazard nature depend upon the type of terminal unit in use, thus:

i When work of a Low Hazard nature has been carried out on a terminal unit which complies with either Para 11 (vi) of HTM 22 or the new British Standard, the installation may be taken into use after the work has been certified by the Authorised Person. Anti-confusion tests and identity tests are not normally required in these circumstances but they may be undertaken at the discretion of the Authorised Person.

ii When work of a Low Hazard nature has been carried out on a terminal unit which does NOT comply with either the requirements of Para 11(vi) of HTM 22 or the new British Standard, the Authorised Person shall carry out a Gas Identity Check at each terminal unit on which work has been completed, before certifying that the installation is suitable for use.

(1)Training is provided at the Hospital Engineering Centre, Falfield

4.6 **Limits of authorisation**

4.6.1 There should be no commencement of work on an existing medical gases installation until the Medical Officer or Authorised Nurse has given written permission, on the Permit, for the work to take place.

4.6.2 Permits should only be issued immediately before work is to start and they should only be issued to Competent Persons.

4.6.3 The Permit should provide concise and accurate information about when and where it is safe and when and where it is dangerous to work. It should provide a clear statement of the work to be done. The estimated time for completion should also be given, but this is for guidance purposes only and should not prejudice the completion of the work in complete safety.

4.6.4 The scope of the actual work done should be limited to that described in Part 2 of the Permit and no one should change the description of the work. In the event of a change in the programme of work, the Permit should be cancelled and a new one issued. This should be cross-referenced to the original Part 1 approval. If the change is no longer covered by Part 1 approval a completely new document should be initiated.

4.6.5 A Competent Person accepting a Permit is, from that moment, responsible for the safe conduct of the work within the limits of the Permit, but the work will be subject to the usual supervision by the Authorised Person and proper commissioning procedure on completion. The Competent Person should not allow himself to be persuaded into breaking the conditions of the Permit. He should make himself fully conversant with its terms and requirements and should give sufficient and clear instructions to persons working under him.

4.7 **Form of Permit**

The Permit is to be in book form, numbered consecutively, with two coloured tear-out copies for use as follows:-

original to Competent Person
second copy to Suitably Qualified Person
third copy retained in book, which remains with the Hospital Engineer.

4.8 **Amendments to Permit**

A Permit should not be amended for any reason.

4.9 **Transfer of Permits**

4.9.1 The Permit may have to extent over two consecutive shifts, in such cases the entries in Parts 2 and 3 of the original and the third copy should be signed by the second Authorised Person and the second Competent Person. Except as stated herein, no Permit should extend beyond two shifts (ie. not normally more than 24 hours, including overtime). A fresh Permit should be issued if the work is still continuing beyond two shifts. The new Permit should refer to the original Part 1 approval if the continuing work is already covered by the original approval; if it is not still covered by the original Part 1 approval a completely new document should be initiated. [This limitation does not normally apply when Permits are issued for the overhaul of central plant.]

4.10 **Work by Contractors**

4.10.1 Permits should be issued to any of a contractors competent staff and artisans who are to be engaged in work which, in any way, presents a hazard to the patients, staff, themselves or the plant. Contracts should be placed only with firms who operate a suitable scheme of employee training and grading, and maintain a Register of tradesmen competent to work without direct and continuous supervision. (See 4.10.2 below)

4.10.2 Employees of specialist contractors having the necessary knowledge and experience may be appointed as Authorised Persons and the contractor should maintain a Register of Competent Persons, whose qualifications should be as in 3.8. Neither the Department nor the Health Authority shall be expected to test the competence of the contractors staff.

Section 5 Procedure

5.1 **Duties**

A summary of the duties of the Authorised Person and Competent Person is set out in Appendix 2.

5.2 **Permission for interruption or restriction of supply**

The Authorised Person should describe to the Medical Officer or the Authorised Nurse the extent to which the supplies will be limited while the work is in progress and should indicate the degree of hazard involved. He should obtain agreement for this limitation and request a signature on Part 1 of the Permit in triplicate. [He should also assist as necessary to ensure that the service is maintained whilst the piped supply is interrupted.]

5.3 **Isolation of Plant**

5.3.1 The Authorised Person should be responsible for the isolation and making safe of the plant to be worked on. (See 2.5.3.1.3 and 2.5.3.2.3 in respect of work on terminal units)

5.3.2 No section of a piped system should be worked on, or pressure tested, unless it is adequately isolated from any section in use or available for use.

5.3.3 Physical isolation, by means of a break point at the "Supply" end of the section to be worked on is essential, except in the case of work on terminal units.

5.3.4 The normal procedure for taking a new branch from an existing main line is described in Appendix 3. The drawings in Appendix 3 show how the new branch is isolated from the existing main line until the new work has been tested and is ready for coupling up and purging with the working gas. They also show how a break point should be established on an existing installation so that work may proceed beyond the break without hazarding the service upstream of the break.

5.3.5 If the tee junction for the new branch can be inserted by a cold jointing technique, the whole of the *existing* installation can be taken back into use immediately after the insertion of the tee junction, provided the interrupted section is purged with the working gas and the cold joints are leak tested by a soap solution or by an ultra-sonic tester.

5.3.6 If a similar cold jointing technique can be employed for establishing a break point, to isolate part of an existing installation so that work may be carried out on it, the section upstream of the break can also be taken back into use immediately after purging and leak testing as in 5.3.5.

5.3.7 If it is necessary to use brazing, instead of the cold jointing techniques in 5.3.5 and 5.3.6, both the upstream and the downstream sections should be taken out of service until they have been tested and found to be free from leaks, contamination, and cross-connection and until the Authorised Person assisted by the Suitably Qualified Person has satisfied himself of the identity and purity of the gas emerging from the restored section on completion of the work.

5.4 Preparation and issue of Permit to Work

5.4.1 After the action as in 5.2 the Authorised Person should prepare Part 2 of the Permit in triplicate. He should identify, from the system drawings, the work to be done and the means of isolation, unless the work to be done is of a Low Hazard nature. Except in the case of Low Hazard work he should normally re-check the Permit whilst looking at the actual installation, to make sure that the possibility of unexpected cross connections has been carefully considered. He should give a brief summary of the work and information on other relevant Permits which are in force. If work is to be carried out only on terminal units complying with paragraph 11(vi) of HTM 22 or the British Standard he should enter in the "Isolation" space "Terminal units have integral isolating valves".

5.4.2 The Competent Person should read the Permit, question anything that he does not understand and then sign Part 3 to certify that he has read and understood it.

5.4.3 The original should then be placed in a protective cover and given to the Competent Person. The duplicate should be sent to the Suitably Qualified Person, the third copy shall remain in the book.

5.4.4 The Authorised Person should ensure that the Competent Person is aware of the need for fire and other safety precautions, particularly if any brazing is to be carried out.

5.5 Action on completion of work

5.5.1 The Competent Person should call the Authorised Person to examine and test the installation.

5.5.2 The Authorised Person should satisfy himself that the work has been satisfactorily completed and should supervise the testing of valve tightness, pressure, anti-confusion, flow rate and delivery pressure, and of the alarm system in accordance with the recommendations of Section XV of HTM 22. He should satisfy himself that the installation is clean internally. [A standard for cleanliness and procedure for testing is under preparation.]

5.5.3 On satisfactory completion of all tests, the Authorised Person should supervise the reconnection of the isolated system to the main system and then purge it with the working gas.

5.5.4 On completion of these operations, the Authorised Person should complete Part 4 of the Permit on the original and third copy and in the case of High Hazard work, invite the Suitably Qualified Person to assist him in carrying out the identity and purity tests and accepting the installation for use.

5.5.5 In the case of High Hazard work, the Authorised Person and the Suitably Qualified Person should complete Part 5 of the Permit when satisfied that the system may be taken into use.

5.5.6 In the case of Medium Hazard and Low Hazard work, the Authorised Person should complete Part 6 of the Permit when satisfied that the system may be taken into use.

5.5.7 The Authorised Person should copy onto the third copy of the Permit the Certificate given on the original (so that the book contains a completed copy of the original) and then file the original.

Section 6 Emergency Repairs

6.1 Normal Procedure

In the event of an emergency, a doctor or nurse should isolate the defective section of an installation, by operating the emergency isolating valves, and notify an Authorised Person by the quickest possible means. The service to the patients should then be maintained by portable apparatus until repairs have been completed.

NOTES:

1. Confusion can arise where more than one profession is permitted to call in Contractors to undertake work on the piped medical gases installation. All such calls should normally be made via the Engineer's Department.
2. Arrangements should be made for the training of staff in the execution of these emergency duties.

Section 7 Design and Construction Implications

7.1 Record drawings

7.1.1 Hospital Engineers at all hospitals with piped medical gases installations should maintain accurate and up to date plans of these installations, showing main sections and branches, departments served, control valves, terminal units and alarm systems for each medical gas service. These plans should be readily available on site for use by any Authorised Person. Their location should be known by all Authorised Persons on the engineering staff of the hospital. Each isolating valve should be individually identified by a code reference or number. The appro-

priate code reference or number, corresponding to that shown on the plans, should be displayed at or on each isolating valve. The plan should indicate whether the terminal units comply either with paragraph 11(vi) of HTM 22 or with the British Standard.

7.1.2 A mimic diagram of the installation is usually helpful.

7.1.3 When additions or alterations are to be made to existing installations by a contractor the Authorised Person should give him two prints from the hospital's master transparency. One copy should be kept on site and corrected in ink daily by the contractor so that it shows the installation "as fitted". On completion of the work the contractor should return one copy of the amended print to the Authorised Person, showing the work actually carried out, for incorporation into the hospital's master plan.

7.2 **Locking of valves and plant rooms**

7.2.1 All valves on the medical gases installations, except those in plant rooms, should be secured in such a way that they can normally be locked in the closed or open position. In the case of those valves which may have to be operated in an emergency the locking system should be capable of being broken. Medical gas plant rooms should be kept locked, except when work is actually in progress in them.

7.2.2 Plant rooms containing medical gas cylinders should be kept locked, with a spare key prominently displayed in a locked box with a transparent front cover at the main entrance, gatehouse or equivalent building, so that in the event of a fire the Fire Brigade Officer may obtain a key immediately he enters the hospital area. The transparent cover should be labelled thus:

> Break glass to obtain key of
> .....
> For emergency use only

7.2.3 The valves in the liquid oxygen installation need not be kept locked. The gate to the liquid oxygen installation should be kept locked and one key of the padlock should be held by a member of the hospital staff at a convenient point close to the installation so that there should be no undue delay when access is required for filling the plant. An indestructible and clear notice stating the location of the key should be securely fixed to each gate of the installation. A duplicate key should be held in a locked box with a transparent front cover as for plant room keys above.

NOTE:
Some Authorities prefer to limit the number of persons who may be allowed to obtain access to keys in an emergency. Where this applies the cover label may read "For emergency use by approved persons only". Where such a limitation is imposed it is essential to display an adequate number of lists of approved persons and to keep the list under periodical review.

PIPED MEDICAL GASES ..... AREA HEALTH AUTHORITY PERMIT TO WORK SERIAL NO.....

PART 1 LEVEL OF HAZARD – HIGH/MEDIUM/LOW

.....
AUTHORISED PERSON

The Piped Medical Gas system supplying (state gases) .....
..... to .....
.....
may be taken out of service for a period of approximately ..... days/hours ..... at ..... (time) on ..... (date)
without hazard to patients

Medical Officer or
..... Authorised Nurse ..... date ..... time

PART 2 SPECIFICATION NO ..... DRAWINGS NO ..... DATED .....

The system(s) is/are isolated as follows at .....
.....
.....
.....
The following work shall be carried out .....
.....
.....
.....
.....
.....
Other associated permits to work in use are ..... issued to ..... date .....
..... issued to ..... date .....
..... Authorised Person ..... date ..... time
..... Authorised Person ..... date ..... time
(taking over)

NO OTHER WORK SHALL BE CARRIED OUT

PART 3

I accept responsibility for carrying out the work as indicated above. No attempt will be made by me nor by any person under my control to work on any other part of the installation. I am fully conversant with the relevant fire and safety precautions required.

..... Competent Person ..... date ..... time
..... Competent Person ..... date ..... time
(taking over)

PART 4 (*Initial in spaces to indicate actual tests completed)

I declare that the work described in Part 2 is now complete. Valve tightness/ */ pressure/ */ anti confusion/ */ flow rate and delivery pressure/ */ alarm/ */ tests have been successfully carried out. The system(s) is/are internally clean/ */ purged/ */ and ready for identity and purity tests. No additional fire hazards exist due to this work. All modifications have been recorded in ink on the pipework, valve, and alarm system "As Fitted" drawings.

.....Authorised Person ..... date ..... time

FOR COMPLETION AFTER HIGH HAZARD WORKS ONLY

PART 5 (*Initial in spaces to indicate actual tests completed)

Identification tests have been undertaken for 0_2 ..... *N_20 ..... *$N_20/0_2$ ..... *Air ..... *Vacuum ..... *

Purity tests have been undertaken for 0_2 ..... *N_20 ..... *$N_20/0_2$ ..... *Air ..... *

The installation may be taken into use.

..... Authorised Person .....Suitably Qualified Person
..... date .....date

FOR COMPLETION AFTER MEDIUM OR LOW HAZARD WORKS ONLY

PART 6

The installation may be taken into use ..... Authorised Person .....date

Original – to Competent Person. Duplicate – to Suitably Qualified Person. Triplicate retained in Book for permanent record and retained for at least two years.

On completion the original should be filed by the Hospital Engineer for a period of at least six months.

Duties of Authorised Person

1. Obtaining permission for interruption of supplies
2. Preparing PERMIT
3. Supervising isolation of section on which work is to be carried out
4. Explaining details of work to Competent Person
5. Supplying drawings of existing sections of the installation "As fitted".
6. Supervising engineering tests of completed work
7. Purging with working gas
8. Final testing, assisted by Suitably Qualified Person in the case of High Hazard work
9. Final testing in the case of Medium Hazard and Low Hazard work
10. Restoring service
11. Making final connection of any extension
12. Obtaining corrected copy of "As fitted" drawing
13. Supervising amendments of office copy of "As fitted" drawing, in ink
14. Copying test certificates from original to third copy of Permit
15. Arranging for filing and safe custody of original and third copy of Permit and all Permit books

Duties of Competent Person

1. Isolating section of system on which work is to be carried out, under direct supervision of Authorised Person
2. Obtaining and understanding instructions on work to be done
3. Signing Part 3 of the Permit, acknowledging responsibility for the work, as indicated in the Permit.
4. Carrying out the work
5. Carrying out Engineering tests on completed work under direct supervision of Authorised Person

PROCEDURE FOR BREAKING INTO AN EXISTING INSTALLATION TO FORM A BRANCH OR FOR WORKING ON PART OF THE INSTALLATION

1. INTRODUCTION

1.1 Three questions arise in the mind of USERS when they are told that a piped installation must be shut down in order that it may be cut into or altered in any way. They are:

1.1.1 How will the patients be served during the interruption.

1.1.2 For how long will the piped supply be off.

1.1.3 How will the safety of the piped installation be affected by work on it.

This Appendix deals only with questions 1.1.2 and 1.1.3, Question 1.1.1 having been referred to at 5.2 of the main text.

1.2 The down time is made up of time required for:

1.2.1 Cutting into the pipe.

1.2.2 Purging the section which will be restored for use when the cut has been made. (In some cases part of the installation has to remain out of use whilst the work is in progress).

1.3 The total down time can be kept to a minimum by the use of cold-jointing techniques, if the work has been properly pre-planned, and where appropriate cold-jointing components are available. The techniques introduce no fumes from brazing, nor residues from flux. Where cold-jointing is carried out, purging of the section is therefore required only for the removal of metal particles at the point of the cut and these will be minimal if a wheel cutter (not a hack saw) is used.

1.4 THEREFORE, WHERE COLD JOINTING *ALONE* CAN BE USED, PURGING WITH MEDICAL AIR IS NOT NECESSARY, BUT PURGING WITH THE WORKING GAS, FOLLOWED BY IDENTITY AND PURITY TESTING IS ESSENTIAL IN ALL CASES.

1.5 Purging with medical air, followed by purging with the working gas will be necessary when conventional brazing techniques have to be used. This is, of course, very time-consuming, though brazing will be the normal procedure for all new work. The brazed work must be purged with medical air, but it may then by incorporated into the existing system by cold jointing. The installation will then require full purging with the working gas, followed by identity and purity testing.

1.6 The safety of the existing installation will be ensured by physically separating the "in-use" section from any new section under construction, or from any part of the existing installation on which work is to be carried out. This separation is in the form of a physical break point.

1.7 In some cases, where the work is of a simple nature, it may be appropriate to take the whole installation out of use while a tee is inserted or other work is carried out.

2. COLD-JOINTING TECHNIQUES

2.1 Fittings suitable for cold-jointing techniques are made by HYDROCUPLIN LTD, INNSWORTH LANE, GLOUCESTER, GL3 1DL, telephone number TWIGWORTH (STD 0452) 730524. The fittings are designed for hydraulic pipes and at present only a limited range of them is compatible with copper pipes to BS659 and BS2871. This range is given in the table below but it may be extended in due course.

BS 659 TABLE A	–	½" NB	¾" NB	1" NB
BS 2871: Part 1: Table X	12mm OD	15mm OD	22mm OD	28mm OD

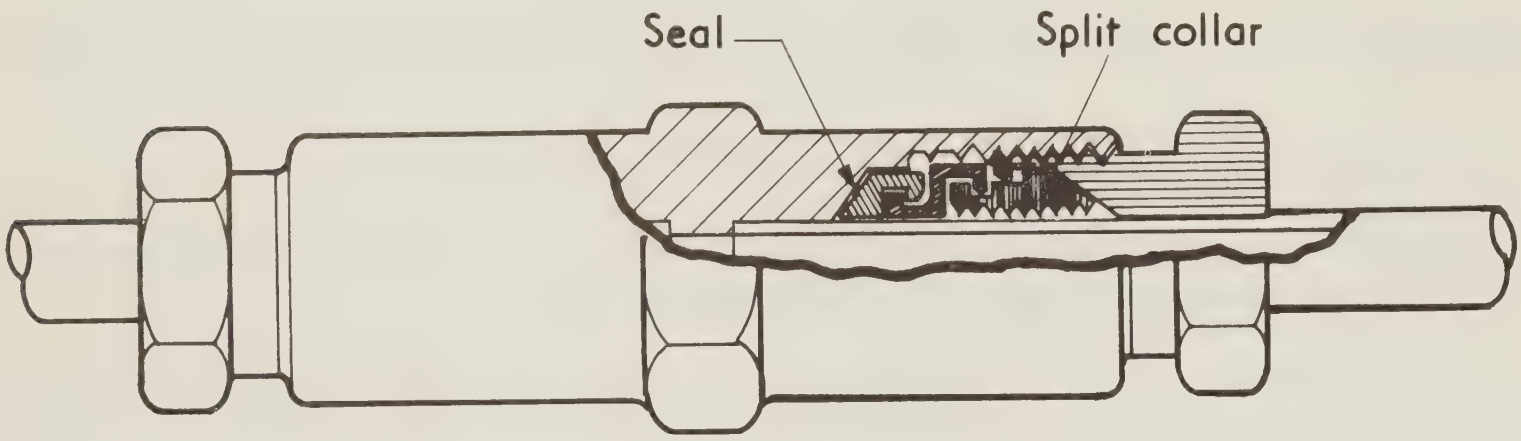
2.2 Any HYDROCUPLIN fitting may be readily converted to or from either of these two British Standard pipe sizes, for example a tee for an existing BS659 pipeline can be assembled as BS659 for the main line and BS2871 for the branch.

2.3 When orders are placed the components should be specified as "ELECTRO-LESS NICKEL PLATED".

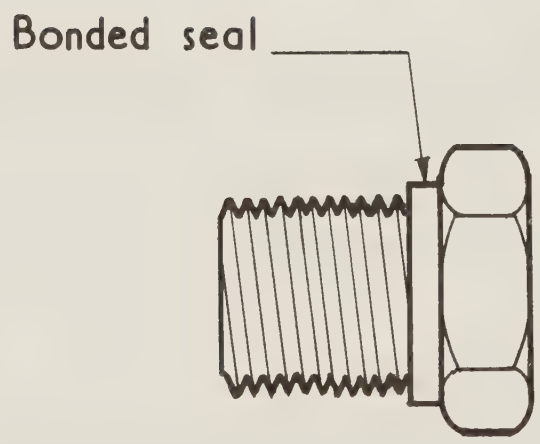
2.4 In some cases, due to tolerances on the BS659, size 1 inch pipe, it may be necessary to reduce the outside diameter of the pipe by a maximum of 0.15mm (0.006 inch). This reduces the pipe wall thickness by less than 10%.

2.5 The general principle of design of these fittings is shown in Fig 1, which is an illustration of a straight coupling. The figure also shows a blank plug which may be needed, as indicated in 3 below.

The action of tightening a HYDROSTUD compresses the seal between the housing and the tube and then closes the split collar onto the tube, locking it in position. The conventional tightening procedure for compression fittings should not be adopted. The tightening torque required for a good gas-tight joint is between 4000 and 8000 kNm, (30-60 ft lbf).



STANDARD STRAIGHT COUPLING



BLANK PLUG (with bonded seal)
may be used in place of a stud in a straight coupling
to cap a pipeline.

Fig. 1 PRINCIPLE OF DESIGN OF HYDROCUPLIN FITTING ®

3. APPLICATION OF COLD-JOINTING PROCEDURE

3.1 Fig 2 indicates an assembly comprising a valve (in a box) and pipe drops, with pipe joints brazed with high duty fittings. It is fully tested and purged with medical air in preparation for final connection into an existing system. [Final purging with the working gas may be accomplished after connection to the existing installation].

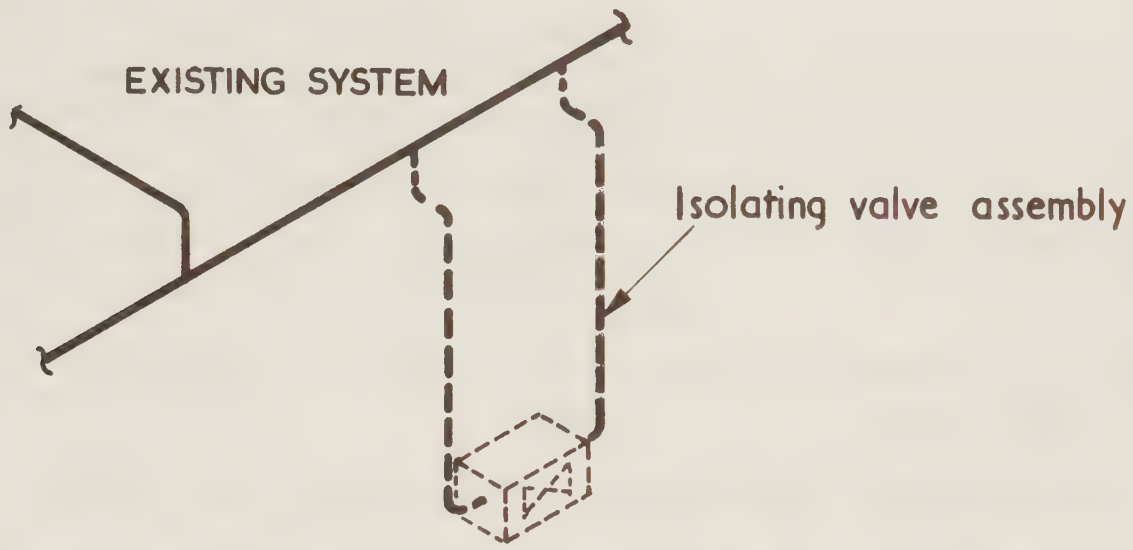


Fig.2 ISOLATING VALVE ASSEMBLY FOR INSERTION IN EXISTING SYSTEM

3.2 If further work is to be undertaken downstream of the valve, a physical break point shall be established downstream of this valve (see Fig 3). The pipe tail upstream of the physical break point should be capped with a plastic cap. The section downstream of the break point will require a pressure-tight capping, so that full pressure testing and purging with medical air of that section may be undertaken. A blank plug is available for this purpose.

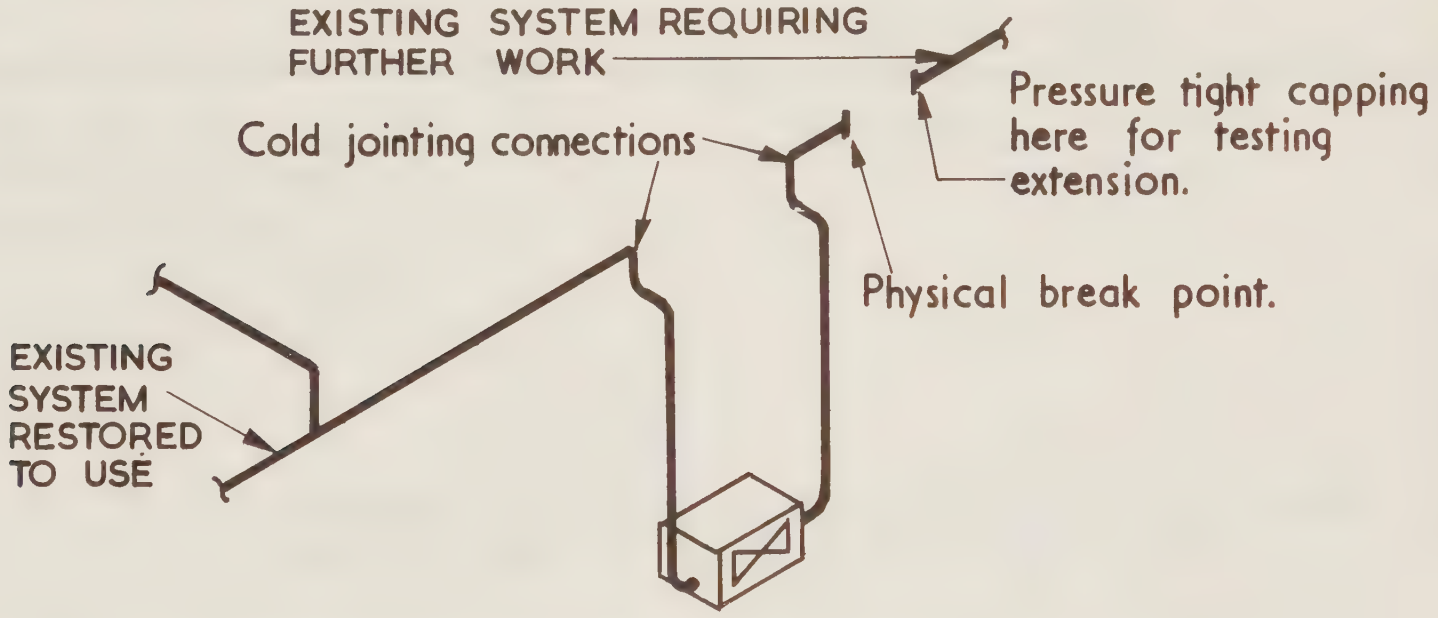

EXISTING SYSTEM REQUIRING FURTHER WORK
Pressure tight capping here for testing extension.
Cold jointing connections
Physical break point.
EXISTING SYSTEM RESTORED TO USE

Fig. 3 ESTABLISHMENT OF PHYSICAL BREAK POINT AFTER INSERTION OF ISOLATING VALVE

3.3 It is not always necessary to provide a valve for the isolation of a section which has to be worked on. For example where a simple extension is required, as in Fig 4, a physical break point is established, the upstream side of the break is capped by a cold jointing connector with a blank plug and the remainder of the system can be taken back into use.

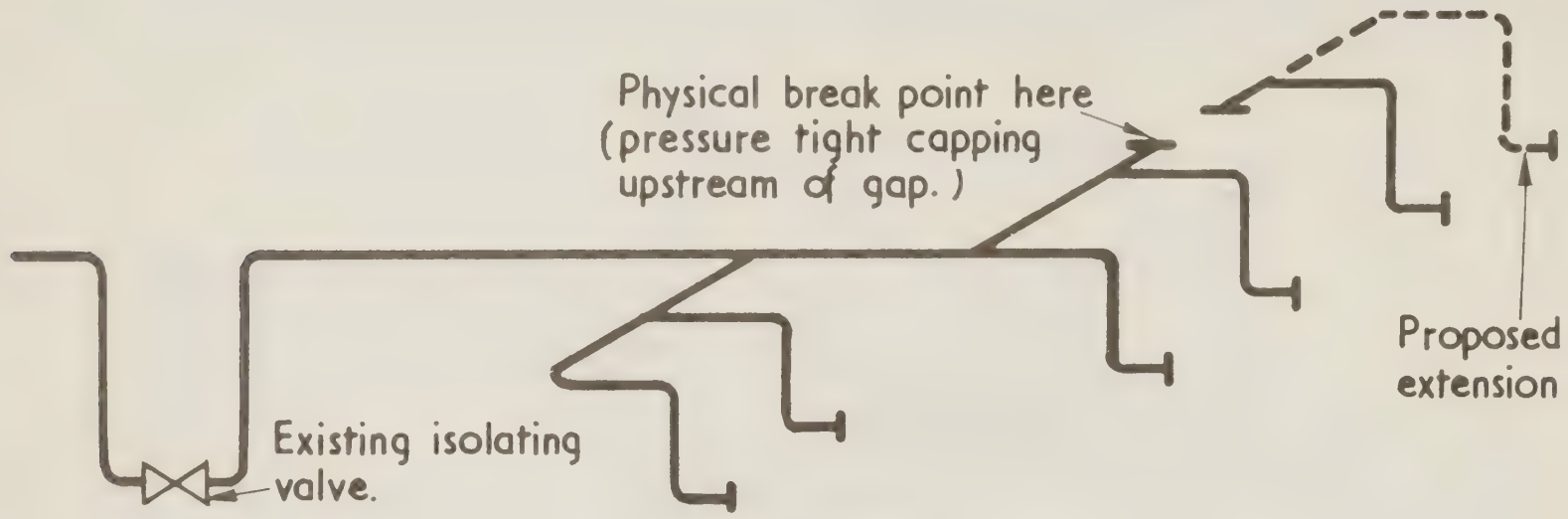


Fig. 4 ESTABLISHMENT OF PHYSICAL BREAK POINT FOR MINOR EXTENSION

3.4 When connecting an extension, the procedure at 3.1 should be followed. If further work on the extension is required downstream of the new valve, a physical break point shall be established as in 3.2, after which the service upstream of the valve may be restored (see Fig 5).

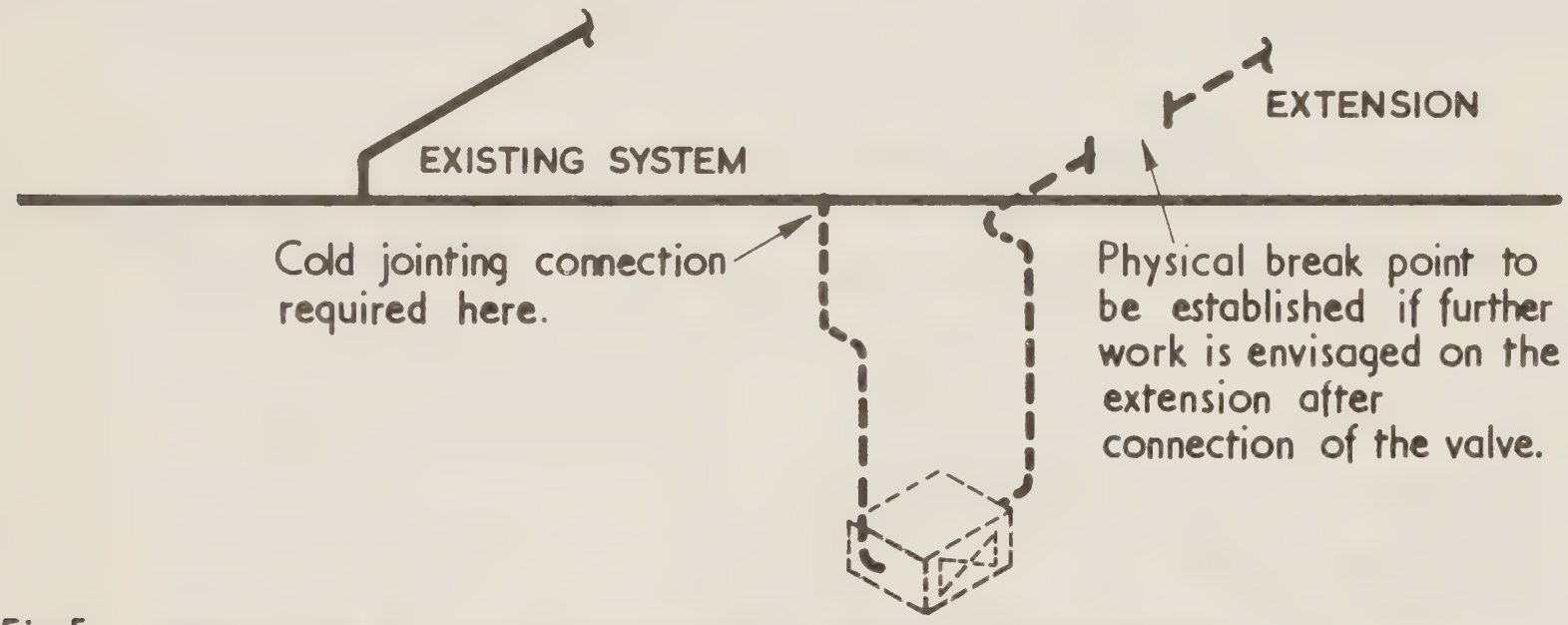
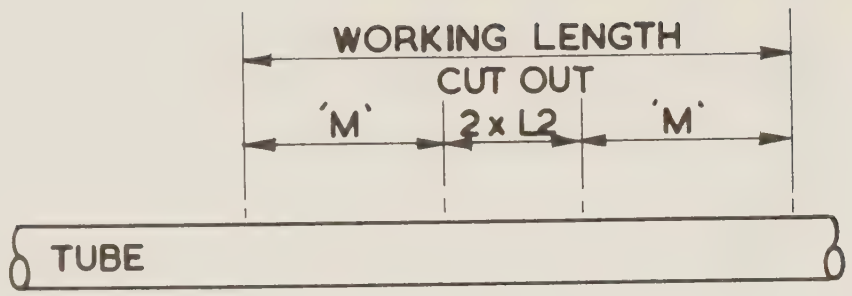


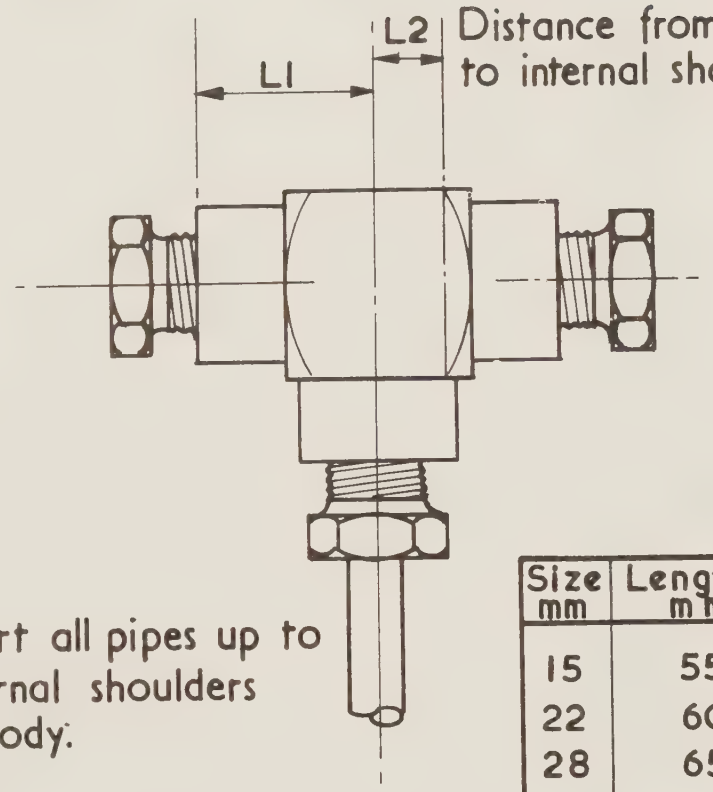
Fig. 5 INSERTION OF ISOLATING VALVE AND ESTABLISHMENT OF A BREAK POINT FOR WORK ON A NEW EXTENSION

3.5 The cold-jointing fittings may be used either conventionally, or with components which slide upon the pipe. The pipes have to be inserted up to the shoulder in the conventional fittings, the alternative assembly is used when the conventional method is not possible. Figs 6 and 7 illustrate the two types of bends and tees. In all cases effective pressure tightness is only achieved if the pipe is thoroughly clean, free from indentations and deformation over the working length and the cut ends are square. Modifications or extensions to installations using pipes to BS2871 may be undertaken and connected to an existing system incorporating BS659 pipes by utilising the full range of components and selecting the appropriate fittings.

3.6 The physical break point may be closed subsequently by means of cold-jointing connections only after the extension or modification has been pressure tested and purged with medical air. AFTER PURGING HAS BEEN CARRIED OUT, THERE MUST BE NO BRAZING ANYWHERE ON THE CLOSURE OR THE MODIFICATION OR EXTENSION. The most simple method of closing the break point employs a short length of pipe and two conventional straight connectors. Straight connectors with sliding couplings may be used when the closure has to be made in a gap of pre-determined length. (See Fig 8).

3.7 The testing of all cold-jointing connections should be done by means of soap solution or by ultra-sonic tester under the pressure of the working gas.

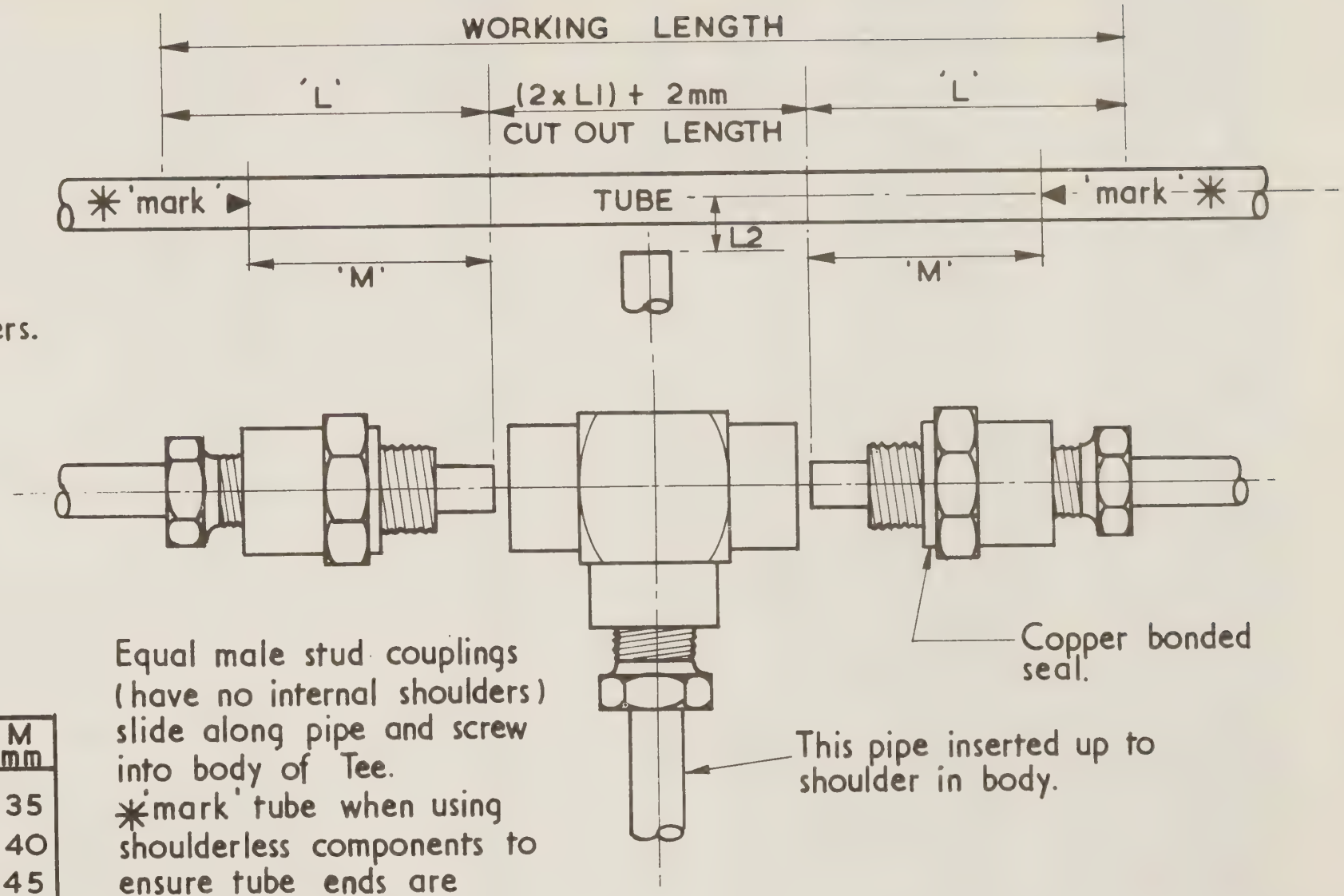




Size mm	Length L mm	M mm
15	55	35
22	60	40
28	65	45

Consult manufacturers literature for dimensions L1 & L2

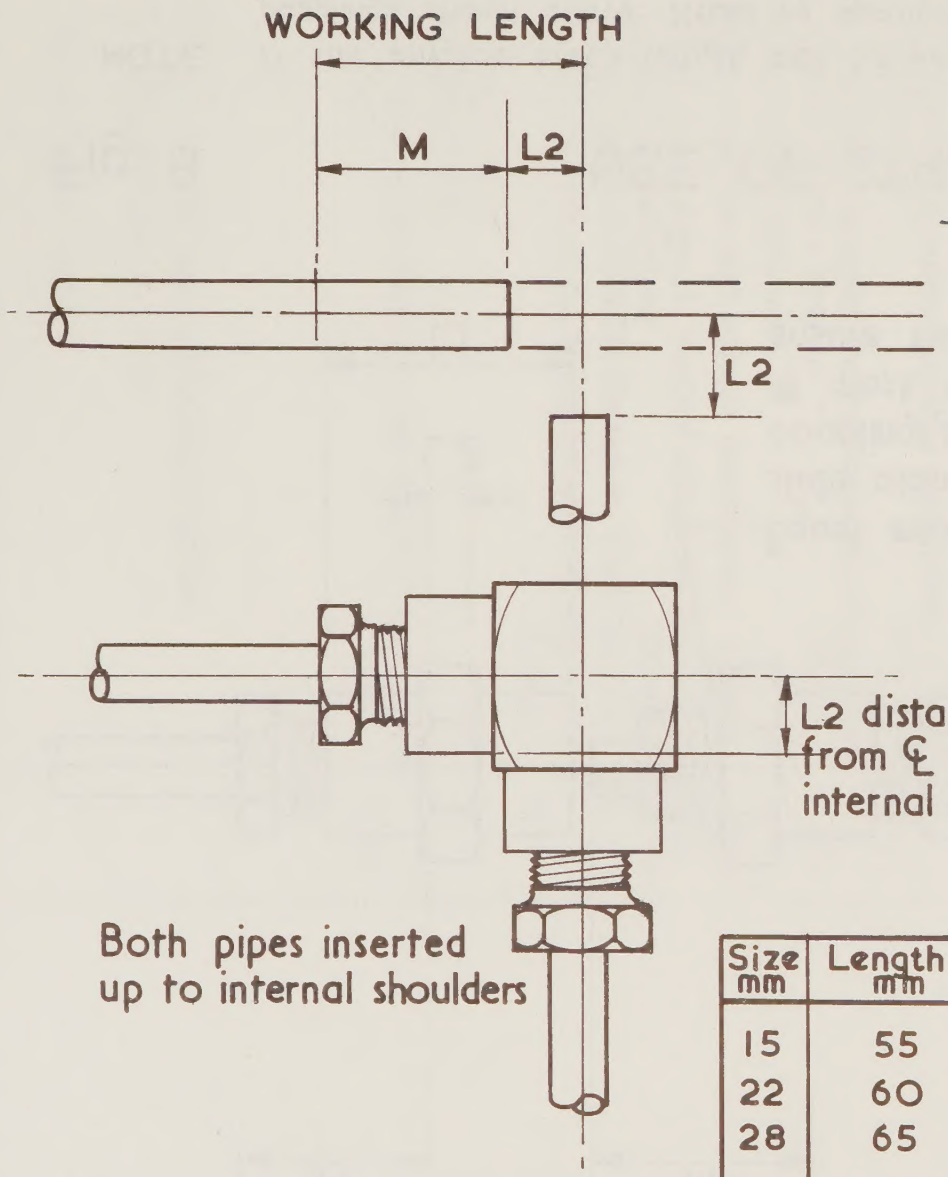
Tee (can be equal or reducing on branch) shown with studs in ports 1, 2 and 3.



Equal male stud couplings (have no internal shoulders) slide along pipe and screw into body of Tee.
*'mark' tube when using shoulderless components to ensure tube ends are beyond the seals.

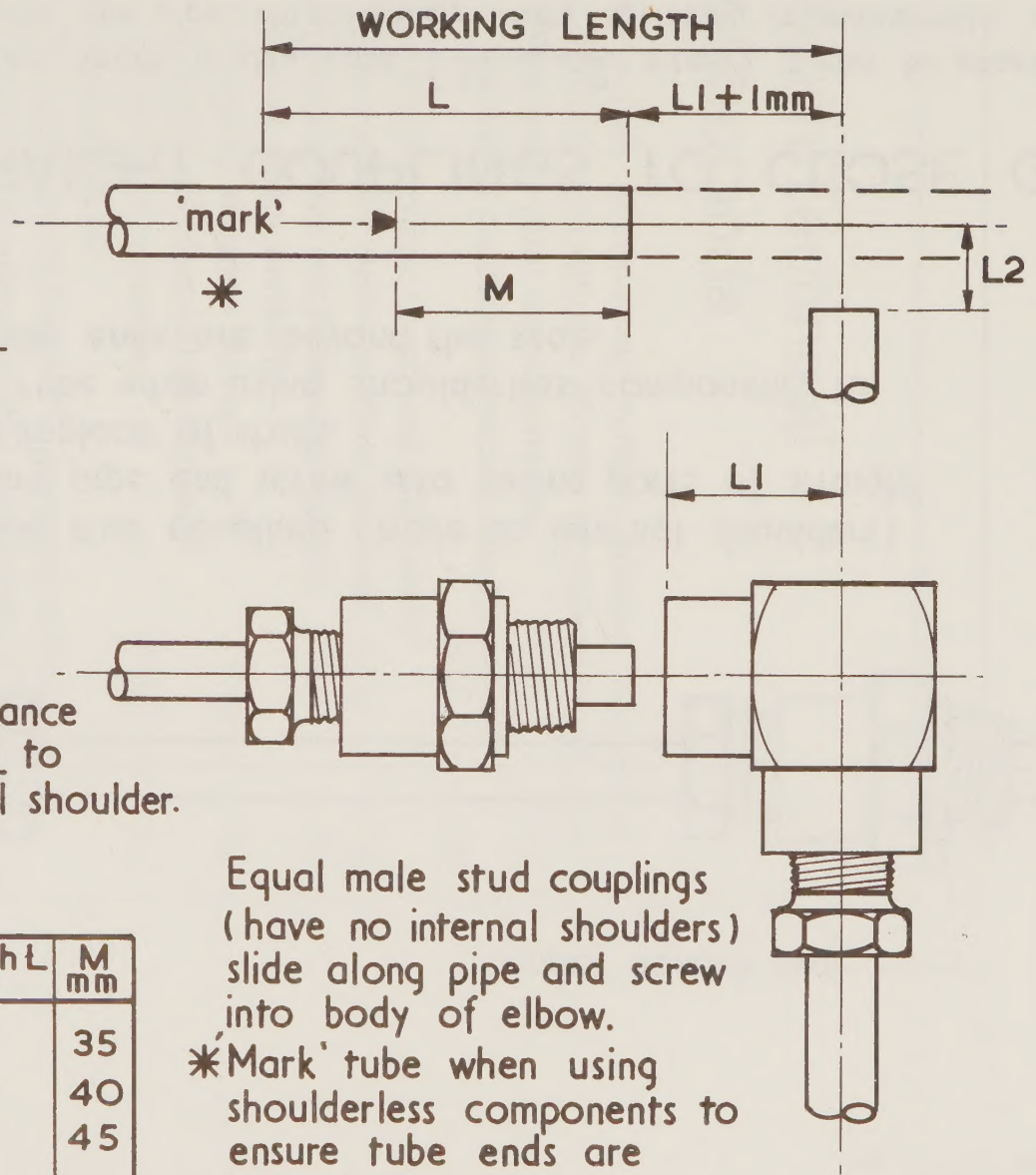
Tee (can be equal or reducing on branch) shown with stud in port 3. Studs in ports 1 and 2 to be replaced by equal male stud couplings.

Fig.6 USE OF HYDROCUPLIN® TEES



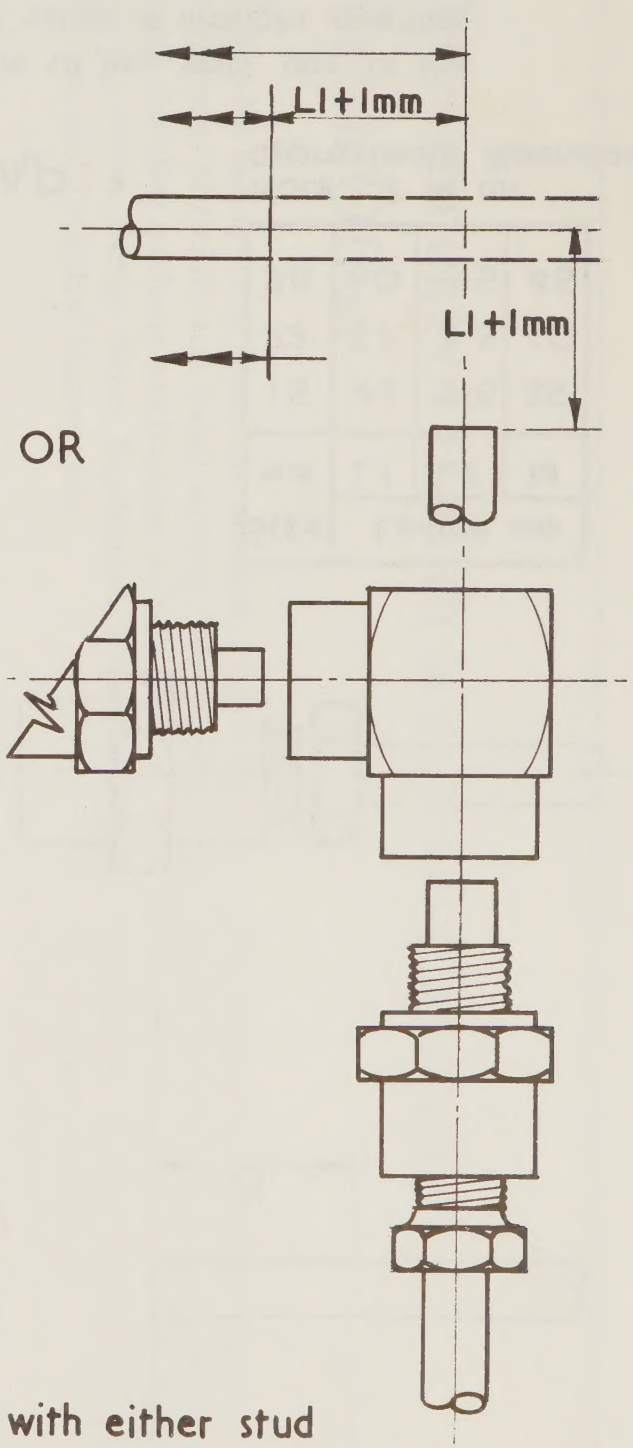
Both pipes inserted up to internal shoulders

Size mm	Length L mm	M mm
15	55	35
22	60	40
28	65	45



Equal male stud couplings (have no internal shoulders) slide along pipe and screw into body of elbow.

*Mark' tube when using shoulderless components to ensure tube ends are beyond the seals.

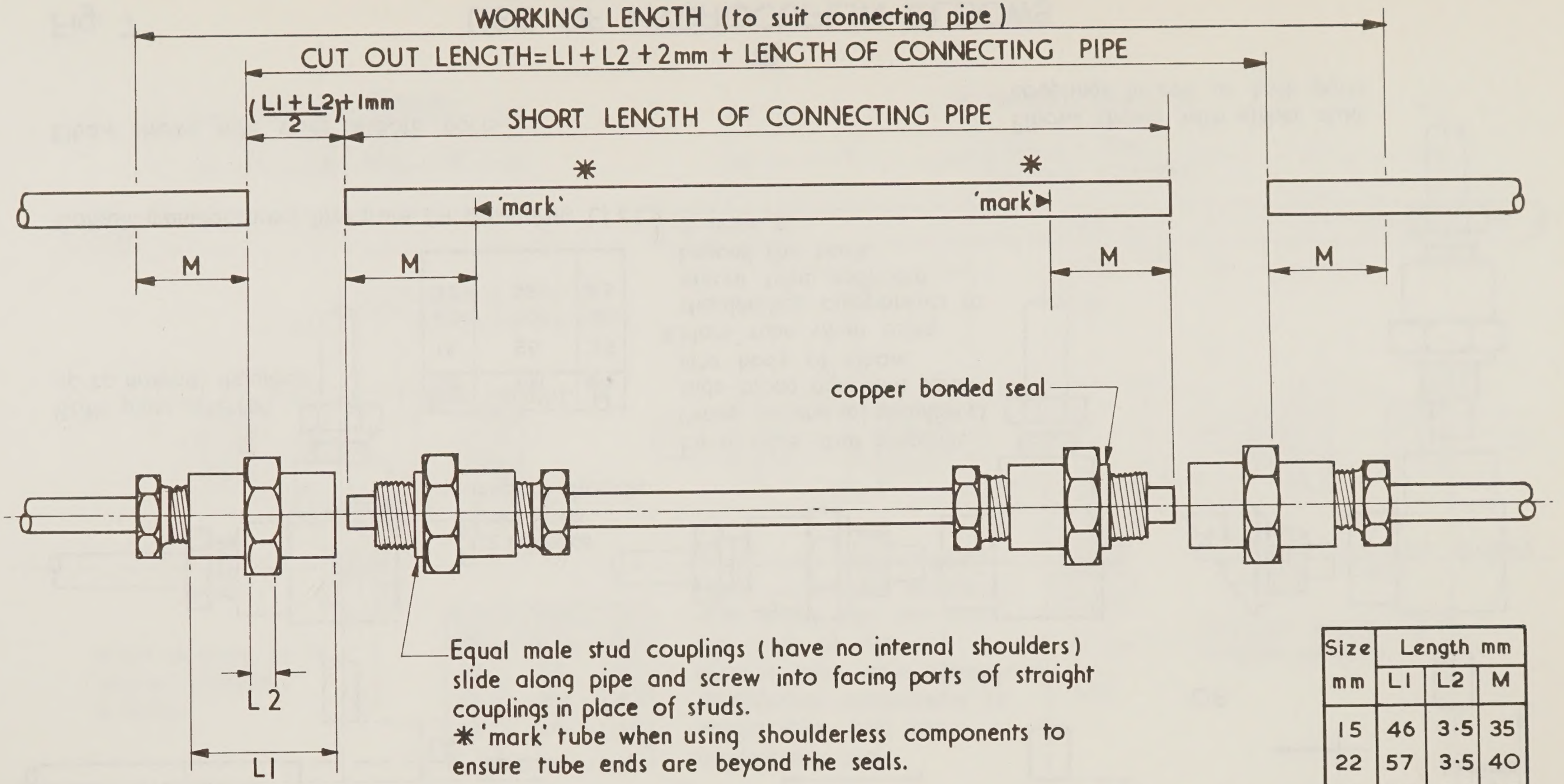


Consult manufacturers literature for dimensions L1 & L2

Elbow shown with studs in both ports

Elbows shown with either stud couplings in one or both ports

Fig. 7 USE OF HYDROCUPLIN® ELBOWS


WORKING LENGTH (to suit connecting pipe)
CUT OUT LENGTH=L1+L2+2mm + LENGTH OF CONNECTING PIPE
(L1+L2)/2 +1mm
SHORT LENGTH OF CONNECTING PIPE
'mark'
'mark'
M
M
M
M
copper bonded seal
L2
L1
Equal male stud couplings (have no internal shoulders) slide along pipe and screw into facing ports of straight couplings in place of studs.
* 'mark' tube when using shoulderless components to ensure tube ends are beyond the seals.

Size mm	Length mm		
	L1	L2	M
15	46	3·5	35
22	57	3·5	40
28	60	3·5	45

Note L2 is an approximate dimension.

Fig. 8 USE OF STRAIGHT COUPLINGS TO CLOSE GAP

NOTE. If the physical break length can be kept short, in this case $\left(\frac{L1 + L2}{2} + 1mm\right)$, it may be possible to use only one of the couplings shown above, fitted by springing the pipe, alternatively where springing is undesirable, by using a straight coupling with equal male stud couplings, which have no internal shoulders, in *both* ports, in a similar manner to that shown for the TEE in Fig. 6.

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